TECHNICAL PROGRESS REPORT 168 NOVEMBER 1968

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ACKNOWLEDGMENTS

The authors express appreciation to Mr. Leon Thevenin, Manager, and M William Hawken, Research Director, of Hamakua Mill Company, Paauilo, Hawa for supplying the seed cane toppings and mill cane strippings used in this study.

Appreciation is also extended to Mr. Tetsuya Yamada for care of expe mental animals and to Mrs. Asako Tanaka for the typing of this report.

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NUTRITIVE VALUE OF SEED CANE TOPPINGS AND MILL CANE STRIPPINGS WITH AND WITHOUT SUPPLEMENTAL PROTEIN[1]

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Sugarcane, recognized as the leading agricultural crop in Hawaii, has considerable possibilities as a source of forage for livestock both as whole plant sugarcane and in the form of by-products.

Whole plant sugarcane was unequaled as a forage in the production of total digestible nutrients (TDN) per acre (2). Analyses of the forage indicated sugarcane to be low in protein content. Chapman, *et al.* (4), have shown increased performance of beef cattle when cottonseed meal was included with chopped sugarcane. Sugarcane by-products are produced in large quantities by the sugar industry, and such sugarcane by-products as seed cane toppings and mill cane strippings are produced and available for livestock forage from normal plantation and sugar mill operations. Henke and Work (5) reported strip cane and napiergrass to be of similar value for milk production when fed to dairy cows, but showed strip cane to have almost double the TDN of napiergrass on an as-fed basis. Digestion trials with mill cane strippings (5) have shown them to be low in protein. Studies at the Hawaii Agricultural Experiment Station (9) indicate that seed cane toppings and mill cane strippings were comparable to mature grasses in TDN content under subtropical conditions.

[1]This study was conducted in cooperation with Western Regional Project W-94, Range Livestock Nutrition.

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The trials reported here were conducted to determine the influence of supplemental protein (soybean meal) upon digestibility and utilization of nutrient components in both the total ration and the forage portion with seed cane toppings and mill cane strippings. The forage portion of each ration was seed cane toppings or mill cane strippings, respectively.

EXPERIMENTAL PROCEDURE

The sugarcane tops used in this study were obtained from seed cane, variety Hawaii 50-7209, approximately 8 months old. The seed cane was grown at an elevation of 800 feet along the Hamakua Coast on the island of Hawaii. The plant nutrients applied during the 8-month growing period for the production of seed cane toppings were 292 pounds of nitrogen, 122 pounds of phosphorus, and 477 pounds of potassium per acre. The rainfall recorded during the corresponding period was 105 inches. The mill cane strippings were obtained from routine sugar mill operations. The sugarcane by-products were dried at 45°C in a forced air, gas heated forage drier, chopped in approximately 1-inch lengths after drying, and stored in plastic bags until fed in the digestion trials. The dry matter contents were 16.4 percent for seed cane toppings and 28.2 percent for mill cane strippings. Composition of the seed cane toppings, mill cane strippings, and soybean meal (SBM) are given in table 1.

Twenty crossbred wethers averaging 108 pounds were used in the digestibility trials. Each sugarcane by-product was fed with two levels of supplemental protein: 0 and 100 grams of SBM per head daily. The animals were placed in metabolism stalls and five animals were randomly allotted to each treatment. The trial period was 21 days long and was divided into three equal 7-day periods—an adjustment, a preliminary, and a collection period. A constant forage intake was established during the adjustment and preliminary periods by feeding each sheep the amount of forage they would consume under a twice daily feeding schedule. Forage offerings for the preliminary and collection periods were held constant at the level established for each sheep during the voluntary intake period. The SBM was fed in equal portions twice daily during all periods of the trial. Water was provided free choice. The seed cane toppings, mill cane strippings, and SBM were sampled at each feeding; total excreta were weighed and sampled (20% aliquot) daily. Urine samples were refrigerated and fecal samples were frozen until analyzed. Chemical analyses of feed, urine, and feces were determined by A.O.A.C. (1960) methods. Gross energy determinations were made using a Parr oxygen bomb, adiabatic calorimeter. The subtraction method (*6*) was used to determine digestibility of the forage portion of total dry matter intake. The data were analyzed statistically by analysis of variance.

Table 1. Composition of seed cane toppings, mill cane strippings, and soybean meal

Forage Ration component	Toppings		Strippings	
	Forage	SBM	Forage	SBM
Chemical analyses, dry matter basis, %				
Organic matter	93.6	93.1	94.5	93.0
Ash	6.4	6.9	5.5	7.0
Crude protein	7.4	48.6	4.4	49.8
Ether extract	1.5	1.4	1.7	1.8
Crude fiber	37.4	6.6	36.2	6.1
Nitrogen-free extract	47.3	36.5	52.2	35.3
Calcium	0.24	0.38	0.32	0.38
Phosphorus	0.14	0.69	0.08	0.69
Silicate	1.12	0.24	1.67	0.24
Gross energy, kcal. per gm. dry matter	4.502	4.692	4.440	4.703

RESULTS AND DISCUSSION

Digestibility of the nutrient components in the total dry matter intake and the forage portion of seed cane toppings and mill cane strippings fed alone and in combination with 100 grams of supplemental SBM are given in table 2. When 100 grams of supplemental SBM was added to the sugarcane toppings, a highly significant ($P < .01$) increase in digestibility was observed for organic matter, crude protein, either extract, nitrogen-free extract, and gross energy in the cane toppings portion of the ration. Crude fiber digestibility was significantly improved ($P < .05$) in the cane toppings with the supplemental protein. A similar trend of highly significant increase ($P < .01$) in the digestibility of all ration nutrients was observed for the complete ration with the addition of 100 grams of SBM.

Digestibility of the nutrient components in seed cane toppings increased in both total ration and the forage portion when supplemented with SBM. This is in agreement with other studies showing that digestibility of low quality roughages (*3, 7*) and 6-week regrowths of kikuyu and pangola grass (*8*) was improved with supplemental protein. The crude protein levels in the total dry matter intake were 7.4 and 13.4 percent for seed cane toppings, when supplemented with 0 and 100 grams of SBM, respectively.

Ether extract was the only nutrient in the forage portion of mill cane strippings portion of the ration where increased digestibility ($P < .01$) occurred with supplemental SBM. A highly significant increase ($P < .01$) in digestibility of organic matter, crude protein and gross energy in the total ration was observed when 100 grams of supplemental SBM was added to the mill cane stripping. Digestibility of ether extract and nitrogen-free extract in mill cane strippings on a total ration basis was increased by the addition of SBM ($P < .05$). A slight but non-significant increase in crude fiber digestibility of the total ration was observed with mill cane strippings when supplemented with SBM. The increased digestibility observed when SBM was added to mill cane stripping was associated with the addition of nutrients in the SBM and not with the increased digestibility of the forage portion. Crude protein levels of 4.4 and 11.1 percent were recorded for total dry matter intake when mill cane stripping was supplemented with 0 and 100 grams of SBM, respectively.

The retention of nitrogen increased for both seed cane topping and mill cane stripping with supplemental protein. However, negative nitrogen balance was recorded for all treatments.

Table 2. Nutritive value of seed cane toppings and mill cane strippings with and without supplemental protein

Forage	Toppings		Strippings	
Daily SBM level, gm.	0	100	0	100
Daily dry matter (DM) intake, gm.				
Forage	526.2	526.2	520.5	520.5
Soybean meal	---	90.4	---	90.2
Total	526.2	616.6	520.5	610.7
Digestibility, total ration, DM basis, %				
Organic matter	47.6[a]	58.8[b]	47.6[a]	54.5[b]
Crude protein	52.5[a]	75.7[b]	17.8[a]	67.6[b]
Ether extract	45.4[a]	53.3[b]	62.8[c]	66.8[d]
Crude fiber	46.2[a]	52.5[b]	45.1[a]	47.5[a]
N-free extract	48.0[a]	58.5[b]	51.3[c]	55.6[d]
Gross energy	45.0[a]	56.8[b]	44.1[a]	51.5[b]
Daily nitrogen balance, gm.				
Nitrogen intake	6.21	13.25	3.64	10.83
Nitrogen in feces	2.95	3.21	2.99	3.51
Nitrogen in urine	6.35	10.45	3.83	8.68
Nitrogen retention	-3.09[a]	-0.42[b]	-3.18[a]	-1.35[b]
Digestible energy, kcal. per gm. DM	2.027	2.574	1.958	2.313
TDN, DM basis, %	45.4	56.0	46.3	52.8
Digestibility, forage portion, DM basis, %				
Organic matter	47.6[a]	54.7[b]	47.6[a]	49.6[a]
Crude protein	52.5[a]	57.3[b]	17.8[a]	19.6[a]
Ether extract	45.4[a]	54.4[a]	62.8[a]	70.3[b]
Crude fiber	46.2[c]	51.4[d]	45.1[c]	47.8[c]
N-free extract	48.0[a]	53.8[b]	51.3[a]	51.1[a]
Gross energy	45.0[a]	53.0[b]	44.1[a]	46.7[a]
Digestible energy, kcal. per gm. DM	2.027	2.388	1.958	2.074
TDN, DM basis, %	45.4	50.8	46.3	47.6

[a,b]Means within a category under the same forage having different superscripts are significantly different ($P < .01$).

[c,d]Means within a category under the same forage having different superscripts are significantly different ($P < .05$).

SUMMARY

Digestion trials were conducted to determine the effects of 0 and 100 grams of supplemental SBM per head daily on the nutritive value of seed cane toppings and mill cane strippings when fed to sheep. The utilization of the nutrients in both the total ration and the forage portion of seed cane toppings were studied. Digestibility of the nutrients in seed cane toppings was improved with the addition of 100 grams of SBM in both total ration and forage portion of the ration. The digestibility of organic matter, crude protein, ether extract, nitrogen-free extract, and gross energy of mill cane strippings was increased in the total ration with supplemental SBM. However, ether extract was the only nutrient in the forage portion which increased in digestibility with the addition of SBM.

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